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FIELD INVESTIGATIONS OF METEOROLOGICAL REGIME OF PLANT COVER

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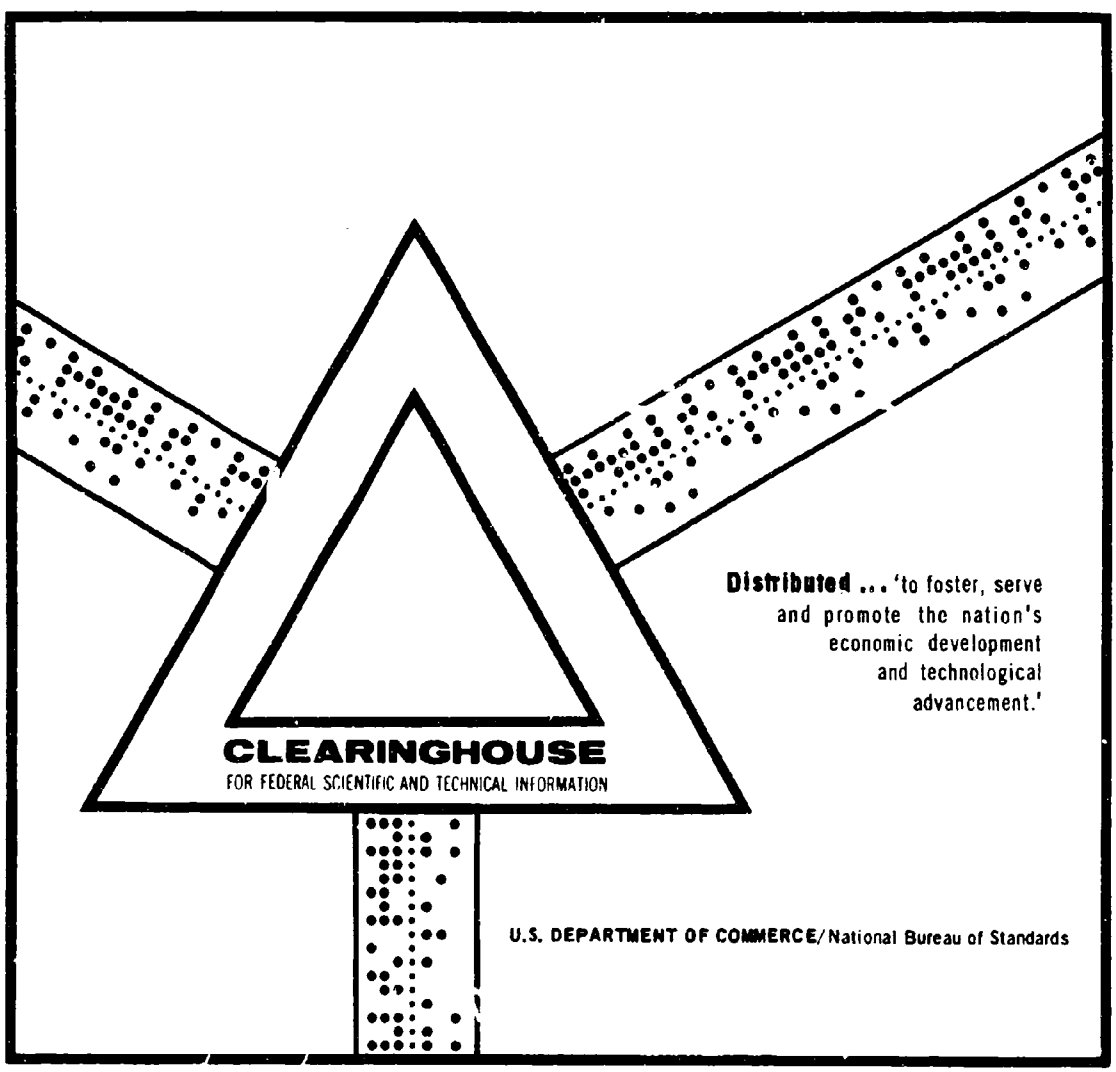

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U.S. ARMY FOREIGN SCIENCE AND TECHNOLOGY CENTER

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FIELD INVESTIGATIONS OF METEOROLOGICAL REGIME OF PLANT COVER

by

N. A. Yefimova

SOURCE: VLIYANIYE METEOROLOGICHESKIKH FAKTOROV
NA FOTOSINTEZ I TEPLOVOY REZHIM
RASTITEL'NOGO POKROVA
GLAVNAYA GEOFIZICHESKAYA OBSERVATORIYA
TRUDY, VYPUSK 229, 1968
USSR

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Experimental observations, the results of which are presented in the present symposium, have been carried out in order to study the effect of meteorological factors on the photosynthetic productivity of agricultural cultures.

The basic task of the expedition was determination of heat-and moisture-exchange, the regime of radiation and intensity of assimilation of carbon dioxide in a layer of the vegetation covering.

It has also been necessary to obtain a series of meteorological parameters and characterics of the vegetation covering, which have been used in calculations of the efficiency of photosynthesis according to a theoretical method developed by M. I. Bugyko, which would make it possible to test this method on material of direct observations.

Data of direct changes in increase of biomass of the vegetation covering over known time intervals should be used as a control for comparison of results of determination of photosynthetic productivity both according to flow of carbon dioxide, and also according to the theoretical method. Thus, in the complex of observations the following were included:

1) gradient observations of the temperature and humidity of the air, and also of wind velocity at 5-6 levels inside the herbage and above it. Observations of temperature and humidity of the soil are required in order to calculate the flow of heat in the soil;

2) actinometric observations of components of the radiation balance according to the standard method and special observations of the change in flux of total radiation, radiation balance and photosynthetically active radiation inside the herbage;

3) obervations of the temperature of individual elements of the vegetation and of the vegetation covering as a whole;

4) measurements of the concentration of carbon dioxide at several levels inside the herbage and above it with the help of colorimetric and opticoaccoustical methods, while a gas analyser directly recorded the carbon dioxide gradient above the crop with simultaneous measurement of thecoefficient of turbulent exchange according to the thermobalance-graph system AFI;

5) biometric observations during the phases of development of the vegetation, of height, denseness of the stand of vegetation per unit area, selection of samples after five days for determination of distribution of area of leaves, stalks and ears of the plants according to height, and also the increase in biomass in the crude and dry form.

In 1965 observations were carried out from June 30 to July 21 in a field of winter wheat of the Lenin Collective Farm, Gatchin District, Leningrad region. In 1966 observations were carried out in the same district at Belogork in a field of winter rye of the Scientific Research Institute of Argiculture of the North-West Zone from June 8 to July 8.

In order to establish samples, regions were selected with herbage of the most even height and density at a distance of 200 m from the nearest edge of the field. The field of winter wheat at an area of about 80 hectares, the field of winter rye-about 10 hectares. The winter wheat (Priyekul' variety 481) during the period of observation went through the phases of flowering, plumping, milk ripening; the winter rye (Vyatek variety)-the phases of ear formation, flowering, beginning of plumping. The plant crops were well developed: the height of the wheat at the beginning of observations was 80 cm, and at the end was 120 cm; the height of the rye was 80 and 175 cm respectively. Rows of winter wheat were oriented from south southwest to north northwest; the winter rye-from southeast to northwest.

Measurements of the temperature and humidity of the air were carried out with aspiration psychrometers with an electric starter, which were suspended in a horizontal position at 4 levels (2 inside and 2 outside the herbage) in 1965 and at 6 levels (4 inside and 2 above the herbage) in 1966 in two repetitions at every height.

The wind velocity was registered by contact anemometers at heights of 0.25, 0.50, 1.00, 2.00 and 4.00 m, also in two repetitions.

The temperature of the surface of the soil was measured with the help of a sixteen-cleavage "thermodistributor" system ASI and at depths of 5, 10, 15, 20 cm with angle therometers.

The temperature of the leaves and stalks was determined with the help of thermodistributors, and of the entire vegetation covering-with radiometers with germanic filters.

Decurrence of direct, dispersed, reflected short wave radiation and the radiation balance were measured at a height of 1 m above the herbage according to the standard method.

Measurement of the total radiation, the radiation balance and the photosyntheticly active radiation inside the herbage were carried out at 4 levels in 1965 (0.20, 0.45, 0.70 and 0.95 m) and at 5 levels in 1966 (0.20, 0.45, 0.65, 1.00 and 1.45 m). In this process thermoelectric pyranometers, balancer and photointergrator (systems of B. I. Gulyayev) were fastened at the transfer rod, which was placed inside the herbage during observations, producing records at 6 levels, while at every level the rod was manually moved horizontally 1.0-1.5 m along the row.

Observations of CO_2 concentration were carried out in 1966 according to a colormetric method [1], while air was drawn simultaneously from 3 levels; the carbon dioxide gradient above the herbage was registered directly with the help of an optical acoustic gas analysers[2].

Testing of the thermobalancegraph system AFI of an improved type, of a series of transmitters and recorders for distance measurement of air, temperature and humidity gradients and also velocity and pulsation-velocity of the wind were carried out on the expedition.

Moreover, the photopyranometer system of B. P. Kozyrev for measuring photosyntheticly active radiation was tested.

Observations were carried out daily with 10 minute series, coordinated to the beginning of every hour from 8 to 18-19 hours. Over the course of each series 8 readings were carried out by cyclometers at every height, anemometers were included for 10 minutes, recording the soil temperature were carried out at the beginning and end of the series.

In 1965, 156 series of observations were carried out with a round-the-clock cycle on June 18-19; in 1966, 263 series were completed.

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[1] Yu. Ye. Girshovich and K. I. Kobak. Investigation of photosynthetic activity of the plant community (cf present symposium).

[2] Yu. Ye. Girshovich. A method of studying carbon dioxide gas exchange of plant communities (cf present symposium).

including 24 hour continued observations on June 12-13 and 15-16.

Weather conditions in July, 1965 were distinguished by grade instability-low temperature in the day time (15°-18°), wind velocity 3-5 m/sec. and considerable cloudiness. Only the last days (July 19-21) were warm and partly cloudy. The soil moisture, especially in the top 20 centimeter layer, was low (5-10%). Data of observations during July, 1965 were average in accordence with three types of weather conditons: cool cloudy weather, air temperature in the day time of 15-17°, cloudiness 8-10 units (on July 6, 9, 11, 14, 16, 18); warm weather with variable cloudiness, air temperature 17-20°, cloudiness 2-7 units (on June 30, July 4, 5, 8, 12, 13, 15, 17); hot weather, air temperature up to 24°, partly cloudy (on July 19-21).

In 1966 the period of observation was also subdivided into three types according to weather conditions: cool (16-20° in the day time), partly cloudy weather (from June 10-17); hot (24-26°), dry with variable cloudiness in the afternoon hours (from June 18-26), and warm (20-22°) with considerable cloudiness, humid weather (from June 27 to July 8). Wind velocity over the course of the entire period was 2-3 m/sec; only June 13 has strong wind (up to 5-7 m/sec). The soil moisture in the period from June 15-28, at the upper layer (0-20 cm) was 5-10%.

In experimental work co-workers of the Department of Climatology of the proper name Mangeaphysical Observatory of N. A. Yefimov (head of the expedition), V. V. Mukagnberg, K. I. Kobak, O. D. Okhotina, Ye. I. Bagrova, Ye. M. Polynskaya, L. N. Gvozdeva, G. V. Menzhulin, candidate of the Mangeaphysical Observatory G. S. Kupchenko, co-workers of the Agriphysical Institute Yu. Ye. Girshovich, M. G. Sanoyan, L. P. Bobin and co-workers of the Leningrad Hydrometeological Institute Yu. A. Kurpakov, N. D. Azimova, Ye. D. Zarubin participated.

Data of gradient observations in a field of winter rye are presented in the supplement according to temperature, humidity of the air, wind velocity, soil temperature.

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13. ABSTRACT

Field studies were carried out in order to determine the effect of meteorological factors on the photosynthetic productivity of agricultural crops. Heat and moisture exchange, the radiation regime and intensity of CO_2 simulation were studied in June and July of 1965 and 1966 in fields of winter wheat and winter rye. Observations were made at various levels within and above the vegetation layer. Gradient observations as to air temperature and humidity, wind velocity, soil temperature are presented in a supplement.

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